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# Analyzing Spatio -Temporal Trend of the Vegetative Cover of the Adansi South Cluster of Forest Reserves in Ghana

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**Abstract:** Variations in forest growth are assumed to be within certain limits due to natural causes such as rainfall and temperature, but not to the extent to which the forest reserve is being exhausted. This study investigated the spatial variations in government forest reserves within the Adansi South District of the Ashanti Region, Ghana, using Landsat images covering a 34-year period at ten-year intervals. The findings indicate a consistent decline in Close Forest (from 29.5% in 1986 to 21.5% in 2020) and Water bodies (from 0.17% in 1986 to 0.14% in 2020), alongside a continuous increase in Open Forest (from 64.7% in 1986 to 66.6% in 2020), Galamsey (small scale illegal mining) (from 0.0% in 1986 to 2.6% in 2020), Built Up Environment (from 0.33% in 1986 to 3.0% in 2020), and Bare Land (from 3.4% in 1986 to 6.5% in 2020). The spatial integrity index for the Adansi South Forest reserve was 57.8%, indicating disturbance from human activities, with 8887 patches detected in the reserve. Shannon's Diversity Index analysis yielded a value greater than 0. Expected land use and land cover patterns for 2025, 2030, and 2040 indicate a persistent increase in Galamsey, bare lands, built-up areas, and open forest, accounting for approximately 81.1% of total land use coverage over the next 30 years, with a decrease in close forest and water bodies (18.9%) in the Adansi South District. It is recommended that illegal mining within protected forest areas be discouraged, and laws regarding illegal entry into protected areas be rigorously enforced.

**Keywords:** Shannon's, Diversity Index, Galamsey, Spatial Integrity Index, Atmospherically Resistant Vegetation Index, LULC, Supervised Classification, Landsat Images

## 1. Introduction

Awareness of vegetative trends and the ability to make precise ecological change predictions are crucial for effective environmental monitoring and management (Richardson et al., 2013). Terrestrial ecosystems are highly sensitive and vulnerable to environmental shifts, primarily driven by global climate change and intensified human activities (Stefanakis, 2019; Xu et al, 2019). Maintaining vegetation is imperative to preserve the terrestrial ecosystem's pivotal role in the land-based biological environment (Hu et a, 2018). Investigating patterns in land surface phenology is essential for understanding how climate and non-climatic factors influence vegetation growth and forest canopy dynamics (Adole te al., 2018). Destruction of vegetative cover has far-reaching consequences for soil quality, climate, and biodiversity (Yengoh, et al., 2015)

The alteration of vegetative cover in forest reserves is a global concern because forests play a vital role in carbon absorption, crucial for preserving global and regional biodiversity. However, human activities like hunting, timber production, wildlife trade, and land-use changes driven by agriculture expansion and climate change affect approximately 80% of the world's tropical and temperate forests, which are distributed globally (Walton et al., 2020) These challenges often have deep historical roots, with many areas transitioning from wild to human-dominated ecosystems over the past two centuries (Mantero et al., 2020).

Even in the most remote regions, such as the Amazon Forest, clear evidence of human impact is visible (Pimentel et al., 1997) Forest degradation and deforestation pose significant threats to Ghana for two primary reasons: forests provide essential resources and environmental functions that support the predominantly agrarian economy (MRV, 2023). The ongoing destruction of Ghana's forests jeopardizes not only the country's economy but also the ability of forest communities to sustainably and economically supply essential goods and services, risking a shift towards becoming a net carbon dioxide producer (Lewis et al., 2015).

To effectively manage forest encroachment practices that impede forest expansion, regular surveillance with human oversight and appropriate technology, such as remote sensing and geographic information systems (GIS), is necessary. However, a joint community monitoring program in the Numiah forest revealed that the Adansi South Forest Commission relies solely on human resources with minimal technological involvement, rendering them ineffective in surveillance. Monitoring extensive forest areas using human resources is impractical and inefficient compared to satellite image analysis (Ampim, et al., 2021) This study aims to assist the Forest Commission in monitoring forest infringements in the Adansi South Cluster of Reserves in Ghana using remote.

## 2.0 Materials and Methods

### 2.1. The Study Site

The study was conducted in Adansi South District in the Ashanti Region of Ghana. The district lies within latitude $4^0$ 40" to North and $6\ ^0$ 22" to North and longitude 1 0 to West and 10 38" to West. The district has a total land area of 1328.2 kilometers square with about 25.2% (334.5sq.km) covered with forest reserve (Forest Commission of Ghana, 2015) (figure 1). With an average height of around 350 meters above sea level, the topography is undulating with some few flat areas. Major rivers like Pra, Fum, Muma, Subin, Menso, Subri, Supong, Krodua, Offin and Aprapo are located in the district. The district is experiencing a double maximum regime of rainfall. The average temperatures are about 29.7°C in mid-day and 21.10°C in the evening. The mean temperature is around 25.39°C.

The district lies within Ghana's vegetative rainforest belt and is characterized by dense semi-deciduous forest with thick vegetative cover and growth. In certain areas of the district, the natural vegetation degenerates gradually into secondary forest. The forest reserves occupy roughly 188.03sq.km in the total region of the district. The Adansi south habours eight government forests. These are Onuem Nyamebe, Kunsimoa, Cheremoase, Nyamebe Bepo, Afia Shelter Belt, Onuem Bepo, Kototintin, Numia, representing a total region of 188.03 km. Wawa, Danta, Edinam, Mahogany, Sapele are several of the varieties of trees contained within the forest reserve. Forest ochrosols is a major soil type in the district. Gold and diamonds are identified as major minerals found in the district. It is located in the towns of Akrofuom, Sikaman, and Nyankomase, which share a boundary with the Obuasi Municipality. Tarkwaian rocks, alluvium rocks and granite are the major rocks which constitute to the soil in the district. Due to the presence of Gold, illegal mining of this precious mineral is rampant. According to 2021 PHC, the Adansi South has a population of 85,200 with 42,552 males and 42,648 females. Agriculture is the primary economic activity of the district. This hires about 60% of the total workforce in the sector. It is known that it is one of the largest cocoa production areas in Ghana. Plantains, coconuts, rice are among the crops grown in Adansi South. Although, the district noted for its agriculture purposes, most of its activities occurred outside the government protected forest reserves. Moreover, the forest is also known to grow snail, mushrooms and forest tress which have led to both legal and illegal chain saw and saw mill operators' business.

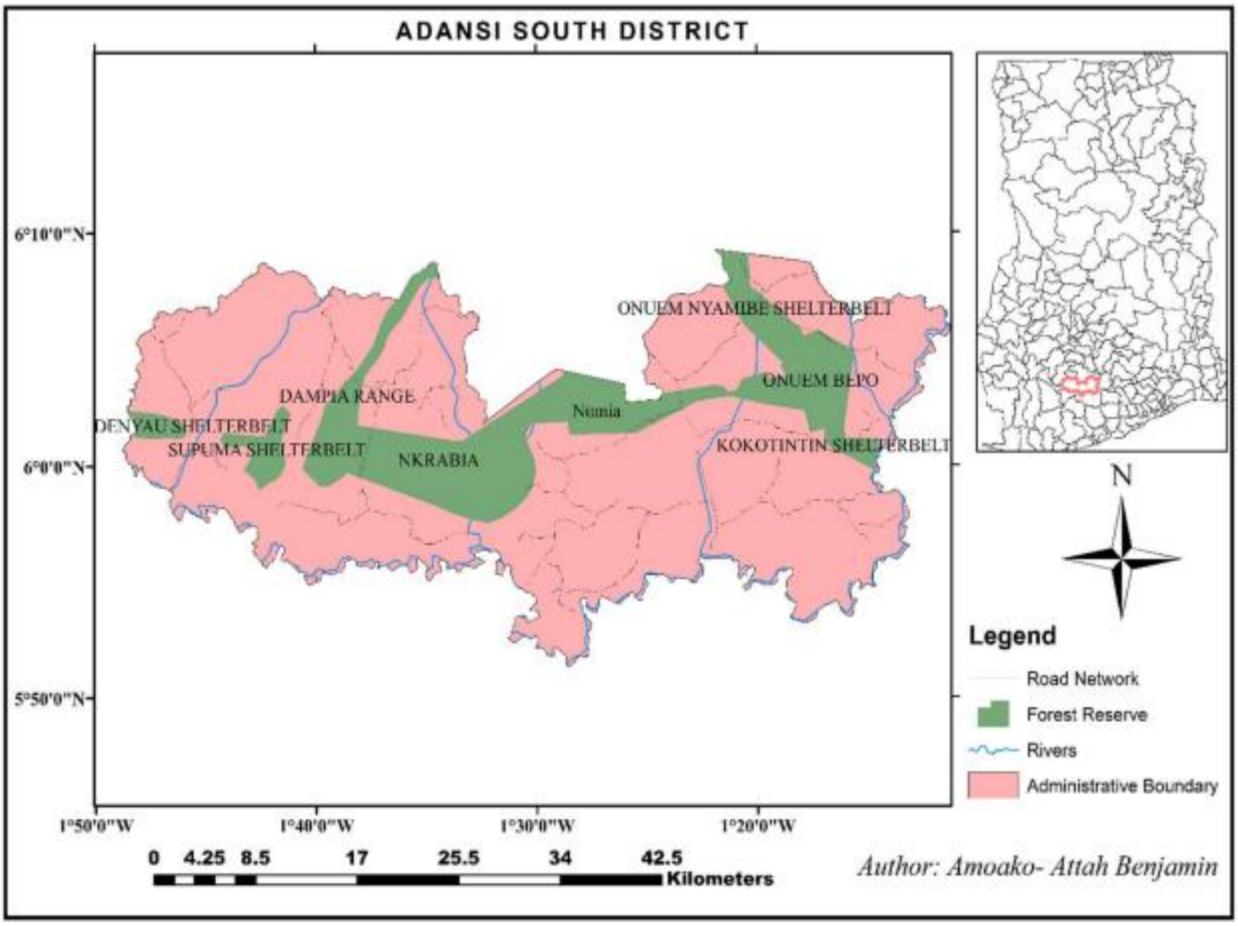



***Figure 1.*** *Study Area map.*

## 2.2 Materials

The study used materials such as shape files, Landsat images, Digital Elevation model and GPS coordinates data of land use type (Table 1).

***Table 1.*** *Materials used in the study.*

| Item | Format | Source | Description/Purpose |
|---|---|---|---|
| Shape files of Ghana and administrative boundaries, Rivers, and Forest Reserves | Vector | forestry Commission (Kumasi Branch, Ghana) an | For masking the satellite images and production of the study area map. |
| Landsat TM, ETM+ and OLI mages | Raster | https://earthexplorer.usgs.gov (Path 194 and Row 56) | These images preferably acquired from 1986, 2000, 2005, 2010, 2015 and 2020. |
| Digital Elevation Model (DEM) | Raster | http://dwtkns.com/srtm30m | The tile covering New Edubiase and Fumso of Ghana was downloaded |

### 2.3 Methods

The methods adopted in this study are classified into three stages: the preprocessing stage, the classification stage, and the post-classification stage.

### 2.3.1. Pre-processing of Data

The atmospheric correction was carried out on all the satellite images acquired from the Landsat. However, the 15 m-by-15 m resolution panchromatic band of the Enhanced Thematic Mapper (ETM+) and Operational Land Imager (OLI) were used to pansharpen 30 m by 30 m resolution image to produce only 15 m by 15 m resolution images which were used throughout the analysis. The gaps in the Landsat 7 images were filled using the gap file for each scene.

The Ground Control Points (GCPs) in the field were extracted and processed. Similarly, DEM data were processed by mosaicking the tiles and making the study area. The boundaries of the forest reserves, the rivers and roads were selected and extracted into individual shape files of the study areas by clipping the study areas boundary.

### 2.3.2 Image Classification

The primary goal of image classification was to automatically classify all pixels in an image into different land cover classes. The classification legend was created using spectral properties. Supervised classification was carried out in three stages: training data sets, classification, and output. For each LULC type to be classified in the image, training samples were collected. To obtain a true representation of the cover classes, training samples were chosen, assessed, and analyzed repeatedly using either delete or merge. The maximum likelihood classifier was used for classification (Lillesand and Kiefer, 1994). This option evaluates spectral properties and establish to which extent a spectral pixel most likely belongs, based on the pixel value. This procedure was followed suit to classify the land use and land cover trend in Adansi South district. After, the transition matrix model was applied on the classified images to reclassified them into change maps. This procedure assisted in identifying the land use and cover changes that have emerged in Adansi South district and as well as major land use conversion.

However, unsupervised classification of the vegetational cover of the forest reserve was carried out to detect the variations in the forest cover using the Atmospherically Resistant Vegetation Index (ARVI), in the raster calculator of QGIS computer application. The formula of ARVI index invented by Kaufman and Tanré, (1992) is basically NDVI corrected for atmospheric scattering effects in the red reflectance spectrum by using the measurements in blue wavelengths (ARVI = (NIR – (2 * Red) + Blue) / (NIR + (2 * Red) + Blue). It therefore spatially classified the pixels in the image into classes of vegetation and non-vegetation on a scale of -1 to 1. The ARVI was considered due to its ability to provide a good result in images that have much atmospheric interferences such as fog or clouds (Kaufman and Tanré, 1992).

Moreover, the classified images were re-classified to predict the land use and land cover trend in Adansi South district. The previously classified images were trained with the ANN and the Transitions Potential Model in the MOLUSCE plugin. It was then simulated with DEM data from the study area, as well as Euclidean distances from the study area's road network and rivers, using the Cellular Automata Model in the MOLUSCE plugin. After that, the simulated land use and land cover trend in Adansi South district was validated, and Kappa statistics were performed. The validated result was used as training data to predict the actual land cover trend in the Adansi South district.

The images classified using the Atmospherically Resistant Vegetation Index (ARVI) was visually interpreted using DN numbers. DN numbers with negative values indicate non-vegetative areas such as water bodies, bare land and built-up whiles DN numbers with positive numbers indicate areas with vegetative cover. Four classes (No Vegetation Cover Grassland, Open Forest and Close Forest) were identified in the classified images. The Ground Control Points (GCPs) were plotted on the classified image to aid the interpretation and accuracy assessments. Figure 1 shows a summary break down of the methodology used in the study.

### 2.3.4 Post Classification

Change in the landscape structure was analyzed using FRAGSTATS version 4 software. FRAGSTATS version 4 is a stand-alone program designed to quantify landscape structure using a wide range of landscape metrics that can be used to describe the characteristics of individual patches, groups of patches, or the entire landscape. It can also quantify the areal extent and spatial configuration of patches within a landscape by comparing and assessing changes caused by LULC conversions (Kaza, 2013). The landscape analysis was performed for the entire study area of the classified images.

Landscape structure was analyzed at the class, the patch and the landscape levels, these metrics were analyzed; Number of Patches (NP), Patch Density (PD), Largest Patch Index (LPI), Percentage of Landscape (PLAND), Total Class Area (CA) and Total Area (TA), Richness Density (PRD), and Shannon's Evenness Index (SHEI). Figure 3 three shows a summary break down of the methodology used in the study.

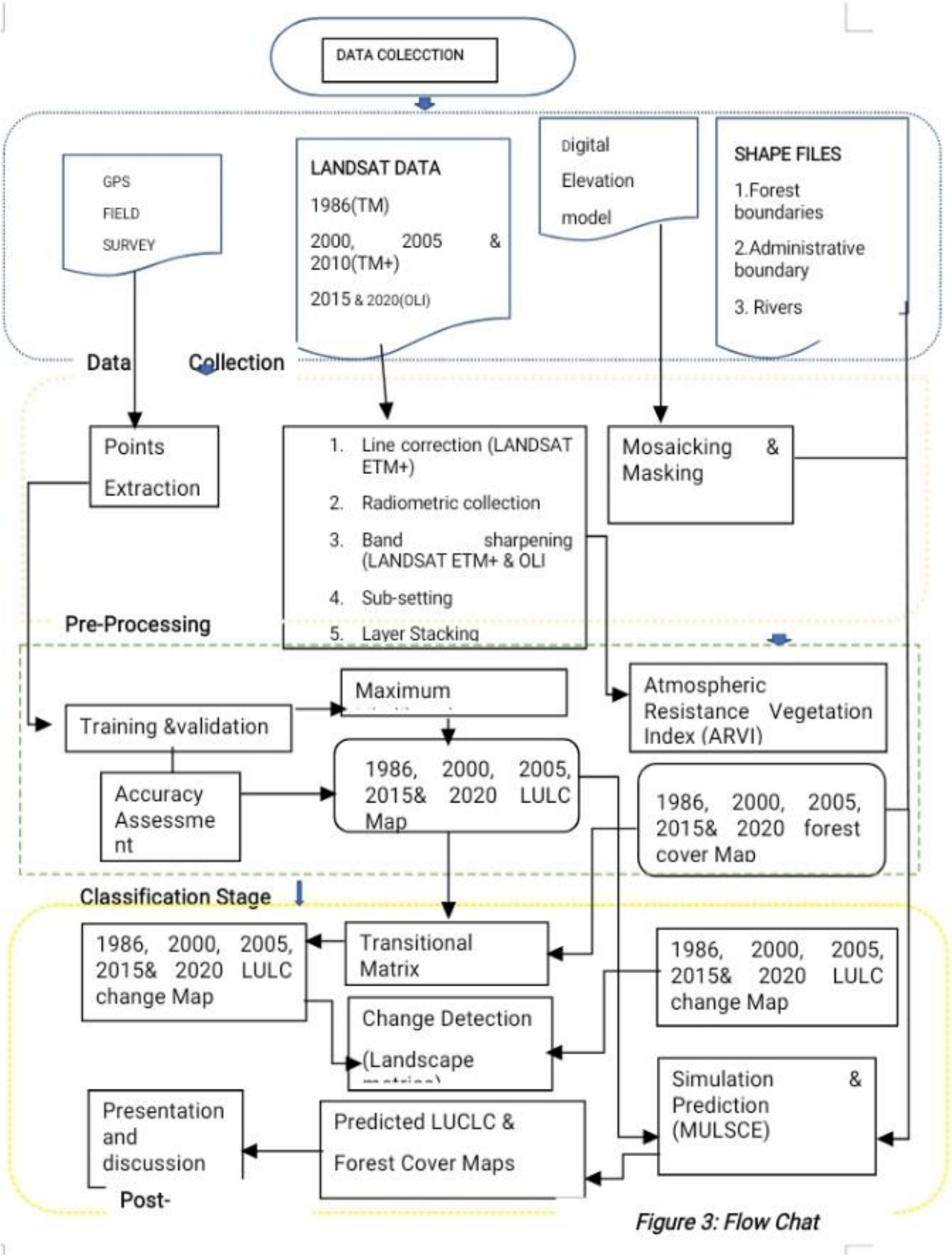



**Figure 2:** Work flow.

strategies.

# 3. Results

## 3.1. Land Use Land Cover Trend in Adansi South District, Ghana

The land use classification data for the Adansi South District from 1986 to 2020 indicates a significant transformation of the landscape (table 2 and figure 3). Over the 34 years, there has been a marked decline in forested areas, with the Close Forest class decreasing from 29.5% to 18%, and the Open Forest class from 66.6% to 61.4%. Concurrently, there has been a notable increase in Bare Land, from 3.4% to 13.8%, and the emergence of the Galamsey class, which represents illegal mining activities, now accounting for 4.9% of the land use. The Built-Up Environment has also expanded, growing from 0.33% to 1.5%, indicative of urban development and potential population growth. Water class fluctuations have been minor, with a slight increase from 0.17% to 0.3%. These changes underscore a shift from natural landscapes to more anthropogenic land uses, highlighting the need for sustainable land management to mitigate environmental degradation and preserve biodiversity. The findings emphasize the importance of ongoing land use monitoring to guide effective policy-making and conservation strategies.

***Table 2.*** *Land use land cover trend in the Adansi South.*

| Year | Land Use Class | Area (ha) | Percentage (%) |
|---|---|---|---|
| 1986 | Close Forest | 39,191.49 | 29.5 |
| | Open Forest | 88,521.75 | 66.6 |
| | Water | 231.12 | 0.17 |
| | Built-Up | 394.20 | 0.33 |
| | Bare Land | 4,513.14 | 3.4 |
| 2000 | Close Forest | 35,195.56 | 26.5 |
| | Open Forest | 89,440.77 | 67.3 |
| | Water | 1,423.98 | 1.07 |
| | Built-Up | 354.20 | 0.267 |
| | Bare Land | 4,740.64 | 3.6 |
| | Galamsey | 1,723.43 | 3.57 |
| 2010 | Close Forest | 31,189.43 | 23.5 |
| | Open Forest | 83,049.00 | 62.5 |
| | Water | 2,070.70 | 1.56 |
| | Built-Up | 8,481.53 | 0.98 |
| | Bare Land | 481.53 | 6.4 |
| | Galamsey | 6,757.16 | 5.08 |
| 2020 | Close Forest | 23,939.10 | 18 |
| | Open Forest | 81,562.07 | 61.4 |
| | Water | 364.03 | 0.3 |
| | Built-Up | 2,022.37 | 1.5 |
| | Bare Land | 18,338.99 | 13.8 |
| | Galamsey | 6,625.15 | 4.9 |

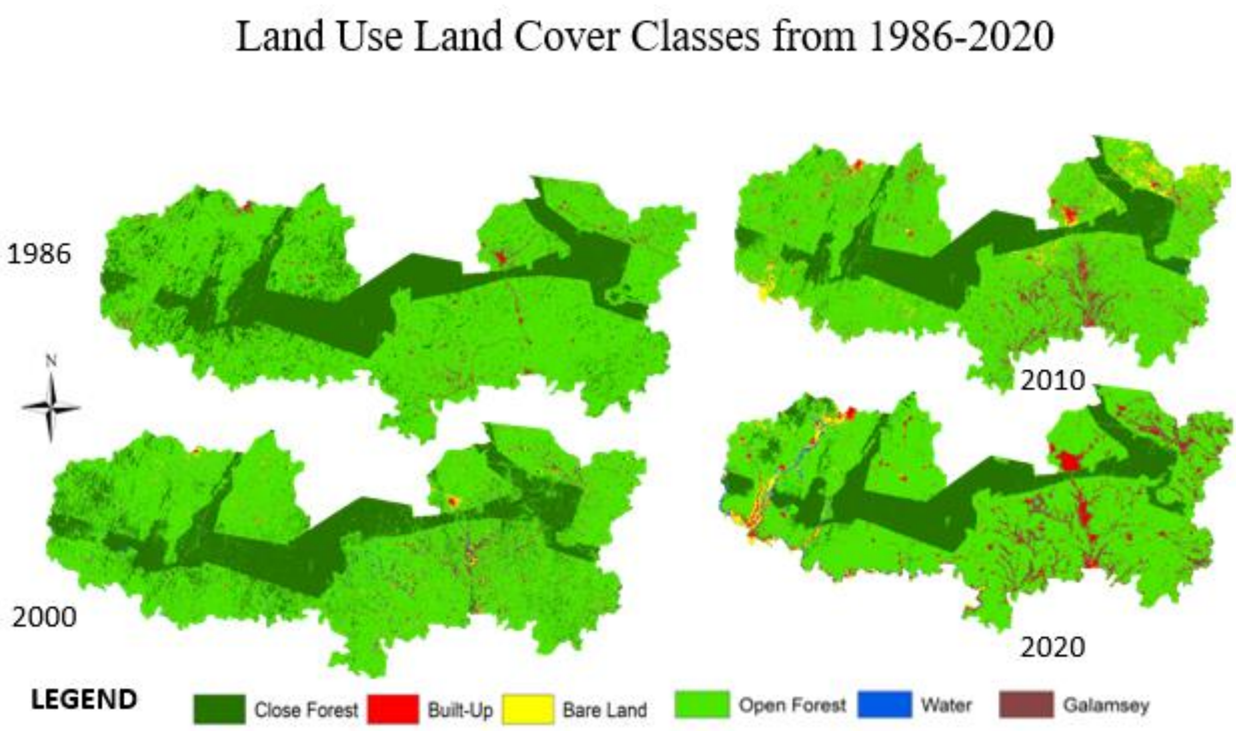



**Figure 3.** Land use land Cover within the Adansi South.

## 3.2. Changes in the Vegetative Cover of the Forest Reserves in Adansi South District

The analysis of vegetative cover within 34 years of the forest reserve reveals significant ecological dynamics (table 3 and figure). The absence of vegetation cover decreased consistently from 537.75 ha (2.00%) in 1986 to 408.4875 ha (1.52%) in 2020, signaling potential natural reforestation or intentional interventions. Grassland areas displayed fluctuations yet experienced an overall increase, rising from

2655.45 ha (9.89%) in 1986 to 758.250 ha (2.82%) in 2020, possibly reflecting alterations in land use or management strategies. Open forest cover remained relatively stable between 67.35% and 70.14%, suggesting a consistent ecological balance. However, closed forest areas initially declined but showed a slight recovery by 2020, fluctuating from 5513.58 ha (20.53%) in 1986 to 5647.927 ha (21.03%) in 2020, possibly indicating past deforestation and subsequent regrowth. Despite the total area remaining constant at 26846.88 ha throughout, the shifting proportions of vegetative cover classes suggest changing ecological dynamics, management practices, or human impact within the forest reserve.

**Table 3.** Variations in the forest cover.

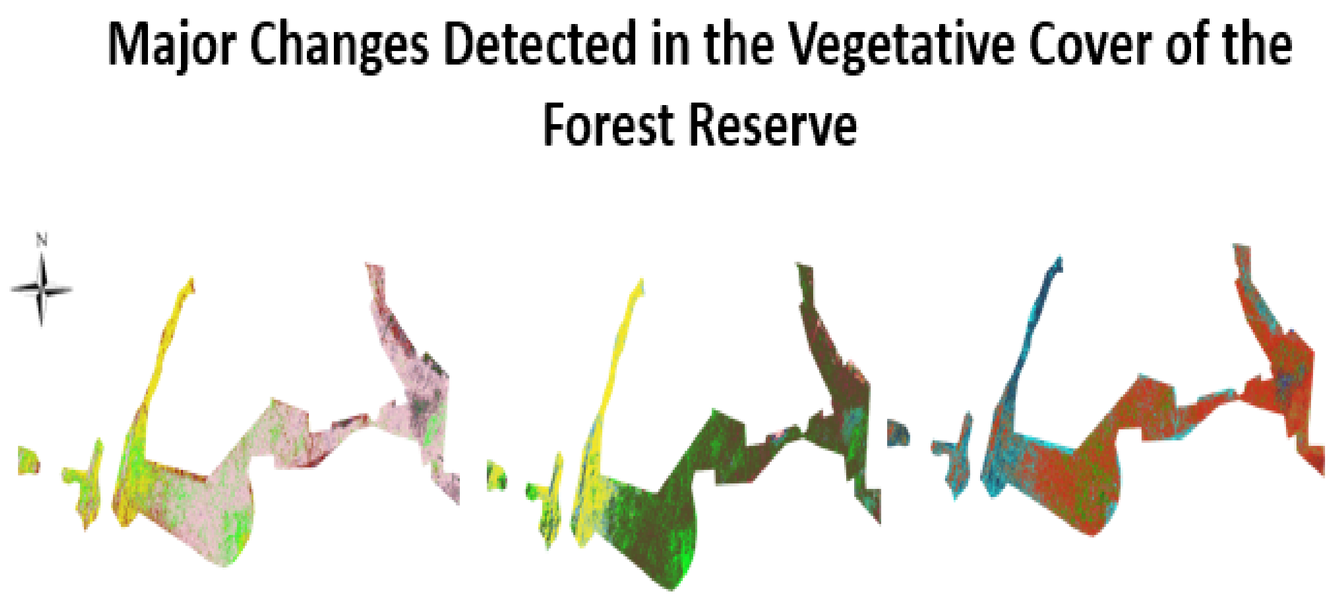
| Year | Vegetative Cover Classes | Area (ha) | Percentage (%) |
|---|---|---|---|
| 1986 | | | |
| | No Vegetation cover | 537.75 | 2.00 |
| | Grassland | 2655.45 | 9.89 |
| | Open Forest | 18140.94 | 67.56 |
| | Close Forest | 5513.58 | 20.53 |
| 2000 | | | |
| | No Vegetation cover | 179.93 | 0.670 |
| | Grassland | 612.02 | 2.279 |
| | Open Forest | 18831.8 | 70.14 |
| | Close Forest | 7223.44 | 26.90 |
| | No Vegetation cover | 179.93 | 0.670 |
| 2010 | | | |
| | No Vegetation cover | 411.81 | 1.53 |
| | Grassland | 761.94 | 2.83 |
| | Open Forest | 18082.59 | 67.35 |
| | Close Forest | 7590.53 | 28.27 |
| | No Vegetation cover | 411.81 | 1.53 |
| 2020 | | | |
| | No Vegetation cover | 408.4875 | 1.52 |
| | Grassland | 758.250 | 2.82 |
| | Open Forest | 20032.22 | 74.61 |
| | Close Forest | 5647.927 | 21.03 |

### 3.3. Fragmentation Analysis on the Vegetative Cover of the Forest Reserve

In detecting the spatial variations that have occurred in the forest zone, fragmentation analysis was carried out on the classified images using Fragstat.4 (Table 4 and figure 4). The naturalness of the forest cover was disturbed as the Shannon's Diversity Index (SHDI) analysis carried on the classified images within the last 34 years was > 0. The SHDI index was very high throughout the years, indicating a strong diversity within the forest cover. Similarly, Shannon's Evenness Index (SHEI) also proved support to the earlier analysis of SHDI as it was also > 0 and very high throughout the years. Meanwhile, the Patch Rich Density (PRD) was constant throughout the 34-year period. Evidently, in the 34-year period, a total number of 8887 patches were detected in the forest zone.

***Table 4.*** *Fragmentation Analysis on the Vegetative Cover of the Forest Reserve.*

| Metrics | Index Year | | | |
|---|---|---|---|---|
| | 1986 | 2000 | 2010 | 2020 |
| Shannon's Diversity Index (SHDI) | 0.6471 | 0.7217 | 0.7885 | 0.7109 |
| Largest Patch Index (Landscape) | 58.4487 | 62.9795 | 60.6268 | 69.3955 |
| Patch Rich Density | 0.0149 | 0.0149 | 0.0149 | 0.0149 |



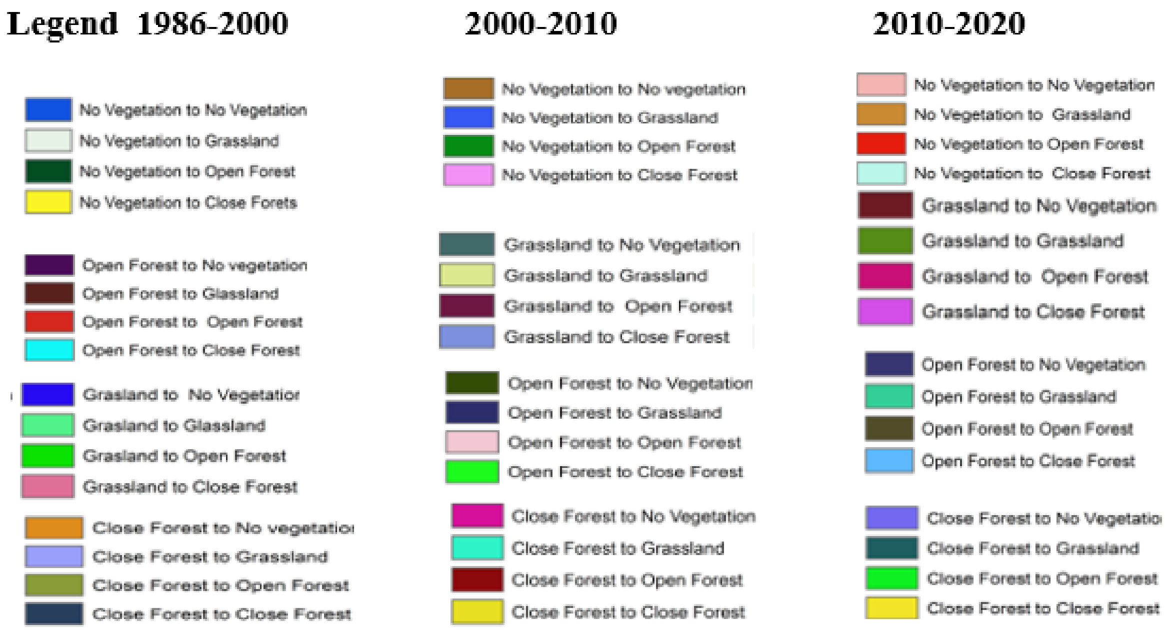



***Figure 4:*** *Major changes detected in the Forest Reserve.*

### 3.4. Spatial Projection of Land Use Trend in the Adansi South

The projected trends depict a potential decrease in close forest cover, declining from 20.06% in 2025 to 18.34% in 2040, suggesting a possible ongoing trend of deforestation or changes in forest density within the region (Table 5 and figure 5). Conversely, open forest areas show a fluctuating pattern, initially dropping to 69.57% in 2030 and then slightly increasing to 73.03% by 2040, hinting at a complex dynamic in forest structure over time, possibly impacted by regeneration efforts or altered land use practices.

Urbanization seems to continue its upward trajectory as indicated by the growth of built-up areas from 2.38% in 2025 to 2.146% in 2040, suggesting ongoing expansion of human settlements. The stability in the percentage of water bodies, hovering around 0.6% to 0.7% across the years, implies a consistent landscape in terms of water resources.

Notably, projections indicate a potential decline in galamsey activities, decreasing from 1.793% in 2025 to 1.050% in 2040, potentially due to regulatory measures or changing economic factors. Conversely, bare land shows a significant increase, expanding from 0.943% in 2025 to 4.80% in 2040, potentially signifying continued land degradation or deforestation processes.

**Table 5.** Spatial Projection of Land Use trend in the Adansi South.

| Year | Land Use Class | Area (ha) | Percentage (%) |
|---|---|---|---|
| 2025 | Close Forest | 26659.98 | 20.06 |
| | Open Forest | 98428.07 | 74.08 |
| | Water | 3169.73 | 2.38 |
| | Built-Up | 956.92 | 0.720 |
| | Bare Land | 2383.24 | 1.793 |
| 2030 | Close Forest | 27994.19 | 21.071 |
| | Open Forest | 92436.95 | 69.57 |
| | Water | 4199.92 | 3.161 |
| | Built-Up | 858.31 | 0.646 |
| | Bare Land | 710.08 | 0.534 |
| | Galamsey | 6652.26 | 5.00 |
| 2040 | Close Forest | 24374.03 | 18.34 |
| | Open Forest | 97030.35 | 73.03 |
| | Water | 2852.03 | 2.146 |
| | Built-Up | 816.25 | 0.614 |
| | Bare Land | 1395.40 | 1.050 |
| | Galamsey | 6383.63 | 4.80 |

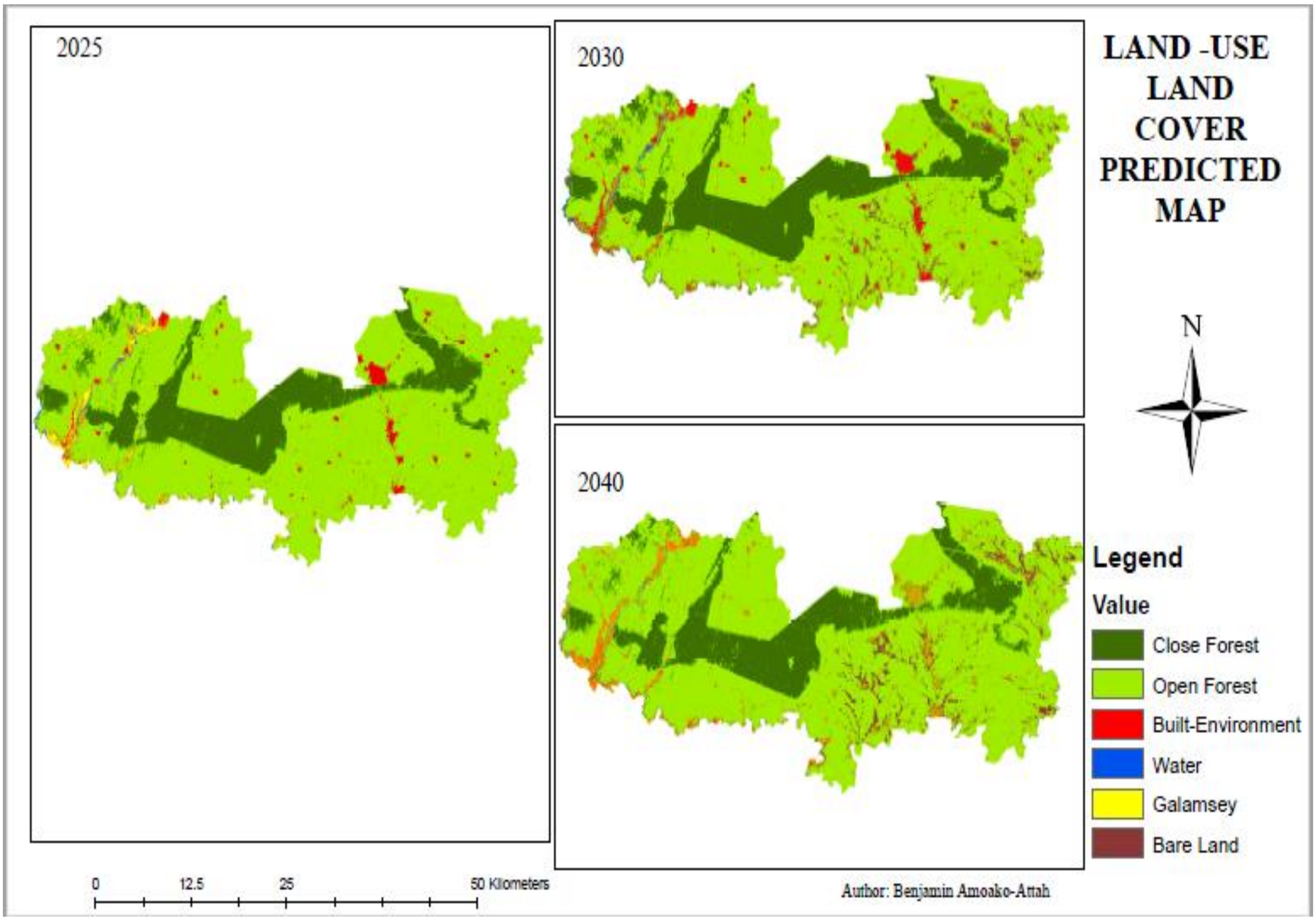



**Figure 5.** Spatial Projection of Land Use trend in the Adansi South.

## 4. Discussion

The results from the study reveal profound changes in the land use, vegetative cover, and fragmentation of the Adansi South District's landscape over the years. From 1986 to 2020, a substantial decline in forested areas, specifically Close and Open Forest classes, has been observed, paralleled by a marked increase in Bare Land and the emergence of Galamsey, representing illegal mining activities. The expansion of the Built-Up Environment indicates urban development, possibly due to population growth. Despite minor fluctuations, the Water class remains relatively stable. These shifts signify a transition from natural landscapes to more human-influenced land uses, urging the implementation of sustainable land management practices to combat environmental degradation and conserve biodiversity. Several researches conducted also revealed similar land conversion as discovered in this study. For instance, a LULC analysis carried out for the previous 24 years in Ghana revealed that barren areas, grasslands, and other vegetation in Ghana experienced significant land coverage decline over 24 years. Despite a rise in agricultural land until 2015, this had minimal impact on crucial crop production (Hassan et al., 2016) In the Greater Accra Metropolitan Area, built-up areas surged by 277 percent over a similar period, revealing substantial expansion in urban spaces. In Islamabad, Pakistan, an increase in agricultural area, built-up area, and water bodies from 1992 to 2012 were observed. However, forest areas decreased dramatically, falling from 34% in 1991 to 6.5 percent in 2015(Hassan et al., 2016). In contrast, the urban extent will massively increase to cover 70 percent of the study area, as opposed to 44 percent in 2015. On the other hand, forest and barren areas followed a declining trend. The three main factors influencing the shift were population increase, climatic change, and economic development. Deforestation and rapid urbanisation have had a variety of negative effects on the ecosystem, including deteriorated habitat quality. Furthermore, in a LULC study conducted in Guangxi, China from 1990–2017 by Hu et al., (2019), found that the woodland lost (deforestation) and woodland acquired (afforestation) were associated with intensive forest practises in the previous 27 years.

Within the forest reserve, the absence of vegetation cover decreased steadily, suggesting potential reforestation or intentional interventions. Fluctuations in Grassland areas reflect changes in land use or management strategies. Open forest cover-maintained stability, while closed forest areas experienced a decline followed by a slight recovery, potentially indicating past deforestation and subsequent regrowth. Despite the total area remaining constant, the shifting proportions of vegetative cover classes underscore changing ecological dynamics, management practices, or human impacts within the forest reserve. Fragmentation analysis using indices such as Shannon's Diversity Index (SHDI) and Shannon's Evenness Index (SHEI) indicated a high diversity and evenness within the forest cover, signifying a disturbance to the naturalness of the forest cover over the 34-year period. The consistent Patch Rich Density (PRD) suggests sustained fragmentation in the forest zone, highlighting the need for conservation efforts to address the impacts of fragmentation on the ecosystem. The findings of this study confront various studies conducted in monitoring of changes in forest reserves around the globe. For instance, according to worldwide forest research, 70% of the surviving forest is located within one kilometer of the forest's edge and is therefore vulnerable to the negative consequences of deforestation due to the fragmentation process (Haddad et al., 2015). Additionally, more than 30% of Ghana's total area was covered by natural forests as of 2010. It lost 136 kha of natural forest in 2020, which is equal to 82.2 Mt of $CO_2$ emissions (Global Forest Watch, 2023). Studies have shown that forests are experiencing major changes in land use due to natural and human cycles, which not only cause a loss of land cover but also a worsening of the ecosystem with negative environmental effects (Song et al., 2018). It is noted that the Sub-Saharan Africa has had a greater rate of rainforest decline than any other region on the globe (Global Forest Watch, 2023)

The projected trends for the coming years indicate potential ongoing deforestation or changes in forest density, along with urbanization's continuous growth, stable water bodies, potential decline in illegal mining activities, and a significant expansion of bare land, suggesting continued land degradation or deforestation processes. These projections emphasize the urgency of proactive measures to ensure sustainable land use, mitigate environmental damage, and preserve the ecological balance in the Adansi South District. The findings from this study revealed similar pattern in previous studies conducted. For instance, a projected land use cover change analysis carried out in Accra Metropolis in Ghana revealed that the urban extent will massively increase to cover 70% of the study area, as compared to 44% in 2015(Addae and Oppelt, 2019). Moreover, a projected land use and land cover change around Odaw River Basin in Ghana reveled that land degradation will be substantial in the northern, western, and the eastern portions of ORB where open forest, bare land, and closed forest are, respectively, transformed to settlement (Ackom et al., 20220). Similarly, a reduction in open and closed forest in the land use was projected in Pra River Basin of Ghana (Awotwi et al., 2019) A forecasting land use land cover change study at Sefwi Wiawso in Ghana, showed that from 2017 to 2024, 877.38 hectares (ha) of close forest resources will convert to open forest resources and other non-forest land cover (Osei-Wusu et al., 2020).

## 6.0 Conclusion

The Adansi South District in Ghana has experienced significant changes in land use, vegetative cover, and fragmentation over the past 34 years. The study reveals a consistent decline in forested areas, particularly Close and Open Forest classes, accompanied by an increase in Bare Land and the emergence of illegal mining activities (Galamsey). Urban development, reflected in the expansion of the Built-Up Environment, is also noted. The analysis within the forest reserve indicates potential reforestation, changes in land use or management strategies, and fluctuations in vegetative cover classes. Fragmentation analysis highlights disturbance to the naturalness of the forest cover. The projections for the coming years suggest ongoing deforestation or changes in forest density, continuous urbanization, stable water bodies, a potential decline in illegal mining activities, and significant expansion of bare land.

In conclusion, the article calls for immediate attention and action to curb deforestation, address land degradation, and implement conservation strategies to ensure the long-term sustainability of the Adansi South landscape

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## Conflicts of Interest

The author declares no conflicts of interest.

## References

Ackom, E. K., Adjei, K. A., & Odai, S. N. (2020). Monitoring land-use and land-cover changes due to extensive urbanization in the Odaw River Basin of Accra, Ghana, 1991–2030. *Modeling earth systems and environment*, *6*, 1131-1143.

Addae, B., & Oppelt, N. (2019). Land-use/land-cover change analysis and urban growth modelling in the Greater Accra Metropolitan Area (GAMA), Ghana. *Urban Science*, *3*(1), 26.

Adole, T., Dash, J., & Atkinson, P. M. (2018). Characterising the land surface phenology of Africa using 500 m MODIS EVI. *Applied geography*, *90*, 187-199.https://doi.org /10.1016/j.rsma.2017.03.003

Ampim, P. A., Ogbe, M., Obeng, E., Akley, E. K., & MacCarthy, D. S. (2021). Land cover changes in Ghana over the past 24 years. *Sustainability*, *13*(9), 4951.

Awotwi, A., Anornu, G. K., Quaye-Ballard, J. A., Annor, T., Forkuo, E. K., Harris, E., ... & Terlabie, J. L. (2019). Water balance responses to land-use/land-cover changes in the Pra River Basin of Ghana, 1986–2025. *Catena*, *182*, 104129. https://doi.org/10.1016/j.catena.2019.104129

Ghana MRV Final Report (ID 67024).pdf." Accessed: Dec. 10, 2023. [Online]. Available: https://www.forestcarbonpartnership.org/system/files/documents/Ghana%20MRV%20Final%20Report%20%28ID%2067024%29.pdf

Haddad, N. M., Brudvig, L. A., Clobert, J., Davies, K. F., Gonzalez, A., Holt, R. D., ... & Townshend, J. R. (2015). Habitat fragmentation and its lasting impact on Earth's ecosystems. *Science advances*, *1*(2), e1500052.

https://doi.org/10.1126/sciadv.1500052
Hassan, Z., Shabbir, R., Ahmad, S. S., Malik, A. H., Aziz, N., Butt, A., & Erum, S. (2016). Dynamics of land use and land cover change (LULCC) using geospatial techniques: a case study of Islamabad Pakistan. *SpringerPlus*, *5*, 1-11. https://doi.org/10.1186/s40064-016-2414-z
Hu, Y., Batunacun, Zhen, L., & Zhuang, D. (2019). Assessment of land-use and land-cover change in Guangxi, China. *Scientific reports*, *9*(1), 2189. https://doi.org/10.1038/s41598-019-38487-w
Lewis, S. M., Gross, S., Visel, A., Kelly, M., & Morrow, W. (2015). Fuzzy gis-based multi-criteria evaluation for us agave production as a bioenergy feedstock. *Gcb Bioenergy*, *7*(1), 84-99. https://doi.org/10.1111/gcbb.12116
Mantero, G., Morresi, D., Marzano, R., Motta, R., Mladenoff, D. J., & Garbarino, M. (2020). The influence of land abandonment on forest disturbance regimes: a global review. *Landscape Ecology*, *35*, 2723-2744. https://doi.org/10.1007/s10980-020-01147-w
Osei-Wusu, W., Quaye-Ballard, J., Antwi, T., Quaye-Ballard, N. L., & Awotwi, A. (2020). Forest loss and susceptible area prediction at Sefwi Wiawso District (SWD), Ghana. *International Journal of Forestry Research*, *2020*, 1-18. https://doi.org/10.1155/2020/8894639
Pimentel, D., McNair, M., Buck, L., Pimentel, M., & Kamil, J. (1997). The value of forests to world food security. *Human ecology*, *25*, 91-120. https://doi.org/10.1016/j.worlddev.2023.106307
Song, X. P., Hansen, M. C., Stehman, S.V., Potapov, P.V., Tyukavina, A., Vermote, E. F., & Townshend, J. R. (2018). Global land change from 1982 to 2016. *Nature*, *560*(7720), 639-643. https://doi.org/10.5194/gmd-2016-75-rc2
Walton, C. R., Zak, D., Audet, J., Petersen, R. J., Lange, J., Oehmke, C., Wichtmann, W., Kreyling, J., Grygoruk, M., Jabłońska, E., Kotowski, W., Wiśniewska, M. M., Ziegler, R., & Hoffmann, C. C. (2020). Wetland buffer zones for nitrogen and phosphorus retention: Impacts of soil type, hydrology and vegetation. Science of The Total Environment, 727, 138709. https://doi.org/10.1016 /j.scitotenv.2020.138709
Yengoh, G. T., Dent, D., Olsson, L., Tengberg, A. E., & Tucker III, C. J. (2015). *Use of the Normalized Difference Vegetation Index (NDVI) to assess Land degradation at multiple scales: current status, future trends, and practical considerations*. Springer. https://doi.org/10.1007/978-3-319-24112-8_4